

REMARKS

Claims 1-20 are pending in this application. Claim 1 is the sole independent claim. The recent personal interview so courteously granted the undersigned by Examiner Chan and Primary Examiner Barton is hereby noted with appreciation.

Claims 1-5 and 9-16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over International Publication No. WO 2004/017452 to Yoshikawa et al., (hereinafter also referred to as "Yoshikawa") as evidenced by European Patent No. 1622178 to Zakeerunddin et al. (hereinafter also referred to as "Zakeerunddin") in view of Japanese Application No. 10-245453 to Tanaka et al. (hereinafter also referred to as "Tanaka"). The cited references do not render unpatentable the present invention.

As is clear from the disclosure of the present application, especially from claims 1 and 5, important aspects of the present invention reside in the electrolyte comprising: (i) a layered clay mineral and/or an organically modified layered clay mineral; and (ii) an ionic liquid.

This electrolyte is useful, as an electrolyte layer, for a photovoltaic device in which the electrolyte layer is located between a photoelectrode and a counter electrode. As disclosed on page 14, lines 5 - 26 of the specification, the "ionic liquid" (e.g., quaternary ammonium salts, imidazolium salts, pyridium salts, pyrrolidinium salts, piperidinium salts) is known in the art and, as shown by the term "liquid", exists in the form of a liquid under ambient conditions (i.e., a room temperature) and, therefore, when used as an electrolyte, the use of a solvent is not necessary, unlike the other conventional electrolytes known in the art. This is completely absent in the cited references.

In addition, as mentioned during the interview, the present invention makes it possible to address some problems associated with conventional electrolytes such as electrolyte evaporation and leakage while showing good power generation over time and performance.

Yoshikawa relates to an electrolyte for dye-sensitized solar cells wherein an oxidation-reduction is carried out by a vulcanized rubber, a polyphosphazene, a porous body comprising a

high molecular material comprising a high molecular material which has a three-dimensional continuous network skeleton structure or an EVA resin film.

According to the Office Action, Yoshikawa teaches an electrolyte comprising a oxidation-reduction substance containing an ionic liquid, e.g. 1,2 dimethyl-3-propylimidazolium iodide, carried by a vulcanized rubber containing clay (abstract; [0112]; [0200 - 0207]).

Also, according to Office Action, Zakeerunddin provides evidence that the "1,2-dimethyl-3-propylimidazolium iodide" is an ionic liquid. However, as previously discussed and as pointed out during the interview, 1,2-dimethyl-1,3-propyl imidazolium iodide is not an ionic liquid, because the 1,2-dimethyl-1,3-propyl imidazolium iodide (i.e., oxidation-reduction substance) is in the form of a solid (i.e., white-light yellow, crystal-powder) at 20°C, which is not a liquid under ambient conditions (please see the previously enclosed Reference 1, i.e., section Ix on page 2 of "Material Safety Data Sheet").

Zakeerunddin was relied upon in the Office Action as defining ionic liquid or "room temperature molten salt" as an electrochemically active salt having a melting point lower than ambient temperature, or a salt selected so that the mixture formed by this salt and another species of the redox system has a melting point lower than ambient temperature, illustrating the general formulae (a) and employing 1,2 dimethyl-3-propylimidazolium iodide in electrolyte example VI (abstract; [0047 - 52]; [0076 - 77]).

In addition, during the interview, the Examiner showed a definition from a website "Organic Chemistry Portal" to exemplify how the term "ionic liquid" is defined more broadly than intended by Applicant. The Examiner also showed webpages from Solaroinix and Ionic Liquids identifying 1,2-dimethyl-3-propylimidazolium iodide, the compound cited in Yoshikawa, as an ionic liquid.

However, Applicant does not agree with this conclusion. In particular, as disclosed in paragraph [0076] of Zakeerunddin, "The electrolyte used for device C contained 0.6 M 1,2-dimethyl-3-propylimidazolium iodide (DMPIT), 0.1 mM M 12, and 0.5 M N-methylbenzimidazole in 3-methoxypropionitrile." The DMPII is used in conjunction with 3-methoxypropionitrile (i.e., a solvent). As described in the attached copy of "High-performance

dye-sensitized solar cells based on solvent-free electrolytes produced from eutectic melts" Yu Bai, Yiming Cao, Jing Zhang, Mingkui Wang, Renzhi Li, Peng Wang, Shaik M. Zakeerunddin and Michael Gratzel, Nature Materials, Vol. 7, August 2008: "1- ethyl-3-methylimidazolium iodide (EMII) and 1,3- dimethylimidazolium iodide (DMII) are solids at ambient temperature on probable account of their high lattice Gibbs energies due to the conformational rigidity of small and symmetric cations" (please see page 626, right column, lines 11 – 15).

Namely, it is disclosed in this publication that EMII and DMII are solid at ambient temperature. Also, please note that Shaik M Zakeerunddin, Peng Wang and Michael Gratzel are three of the coinventors of Zakeerunddin et al. and co-authors of this publication. .

In addition, as appreciated by the examiner Yoshikawa does not teach that the clay contains a layered clay mineral and/or an organically modified layered clay mineral as recited in claim 1 or that the layered clay mineral and/or organically modified layered clay mineral is produced as in claims 2 or 3. The Examiner relied upon Tanaka et al. for a disclosure of this feature.

Yoshikawa merely suggest the use of clay (note: not the layered clay mineral) along with a number of other fillers in the vulcanized rubber. As is well known in the art, the "clay" mentioned in Yoshikawa is used, as a filler such as carbon black, silica, calcium carbonate and the like. In addition, the vulcanized rubber is not used in the present invention.

Consequently, the use of the ionic liquid and the use of the layered clay mineral (even the clay) in an ionic liquid are completely absent in Yoshikawa.

Even though a *prima facie* of obviousness has not been established, as discussed above, nevertheless, enclosed is a Declaration under 37 CFR 1.132 by Dr. Tsukasa Maruyama, one of the co-inventors of this application. The Declaration is presented to further evidence the unexpected and improved results obtained from employing the layered clay mineral as compared to various fillers suggested in Yoshikawa. In the Declaration, Clay Gel Electrolyte A is in accordance with the present invention. Electrolyte B (Comparative), Electrolyte C (Comparative) and Electrolyte D (Comparative), employ carbon black, talc and calcium carbonate, respectively in place of the layered clay mineral used in Clay Gel Electrolyte A. As stated in the Declaration,

and as is clear from the results shown in Table I therein, when the clay gel "Electrolyte A" is used, the current-voltage characteristic is higher, when compared with those of the comparative "Electrolyte B" (carbon black), "Electrolyte C" (talc) and "Electrolyte D" (calcium carbonate). Dr. Maruyama then concluded in his Declaration that the use of the clay gel electrolyte is superior to the use of the carbon black, talc and calcium carbonate, instead of the clay gel, because the cell of the above Experimental I using the clay gel shows higher current-voltage characteristic than the cells of Experimental II-IV using the carbon black, talc and calcium carbonate, respectively. Dr. Maruyama further confirmed that he believes "that the present invention is by no means obvious from the Prior Arts."

All evidence must be considered in evaluating the non-obviousness of the invention. Please see *KSR Int'l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727; 82 USPQ2d 1385 (2007) and *In re Sullivan*, 498 F. 3d 1345 (Fed. Cir. 2007). Furthermore, when evidence of non-obviousness is present, the Office should reconsider any initial obviousness determination in view of the entire record. Please see *In re Piasecki*, 745 F.2d 1468, 223 USPQ 785 (Fed. Cir. 1984) and *In re Eli Lilly & Co.*, 14 USPQ2d 943 (Fed. Cir. 1990) and Examiner's Guidelines Update: Developments after KSR v. Teleflex, Federal Register/Vol. 75, No. 169/Wednesday, September 1, 2010/Notices page 53657.

In addition, Yoshikawa does not lead one skilled in the art to select a clay as the "lead" filler therein and then to modify the clay to achieve the results according to the present invention. None of the examples in Yoshikawa employs clay. The only filler used in an example was carbon black. Where, as here, the prior art does not lead to select the composition relied upon by the Office as the lead or reference composition, the Office has not established a *prima facie* case of obviousness. Along these lines, please see *Unigene Laboratories Inc. v. Apotex Inc.* 99 USPQ2d 1858 (Fed. Cir. 2011), *Eisai Co. Ltd. v. Dr. Reddy's Labs.*, 533 F.3d 1353, 1356 (Fed. Cir. 2008), *Daiichi Sankyo Company, Ltd. v. Matrix Laboratories, Ltd. et al.* 96 USPQ2d 1526 (Fed. Cir. 2010) and *Takeda Chem. Indus., v. Alphapharm Pty. Ltd.*, 492 F.3d 1350, 1356-57 (Fed. Cir. 2007).

Tanaka was relied upon for a disclosure of a clay composite rubber material comprising layered clay minerals, modified by gum oligomers and organic onium ions. However, Tanaka does not overcome the above discussed deficiencies of Yoshikawa and Zakeerunddin with respect to rendering unpatentable the present invention. In fact, Tanaka is not reasonably pertinent to the problems addressed by the present invention. Therefore, Tanaka is not even art that is analogous to that of the present invention. Accordingly, Tanaka is not usable in the rejections of the claims. Please see *In re Klein*, 98 USPQ2d 1991 (Fed. Cir. June 2011) and *Unigene Laboratories Inc. v. Apotex Inc.* 99 USPQ2d 1858 (Fed. Cir. August 2011) and the Memorandum entitled “Analogous Art for Obviousness Rejections” by Robert W. Bahr, Acting Associate Commissioner for Patent Examination Policy dated July 26, 2011. Also see *King Instrument Corp. v. Otari Corp.* 757 F2d 853, 226 USPQ 402 (Fed. Cir. 1985), cert denied 475 US 1016 (1986), appeal after remand 814 F2d 1560, 2 USPQ2d 1201 (Fed. Cir. 1987); *Ryko Manufacturing Co. v Nu-Star Inc.* 950 F2d 714, 21 USPQ2d 1053 (Fed. Cir. 1991); *In re Clay* 966 F2d 656, 23 USPQ2d 1056 (Fed. Cir. 1992); *In re Oetiker* 977 F2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992) and *Wang Laboratories Inc. v Toshiba Corp.* 993 F2d 858, 26 USPQ2d 1767 (Fed. Cir. 1993).

Moreover, Tanaka does not suggest the improved results achieved by the present invention and as evidenced by the results in Declaration by Dr. Maruyama.

Claims 6-8 and 17-20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa et al., Zakeerunddin et al. and Tanaka et al., in view of U.S. Patent Publication No. 2005/0072462 to Kang et al. (hereinafter also referred to as “Kang”). Kang does not overcome the above discussed deficiencies of Yoshikawa, Zakeerunddin and Tanaka with respect to rendering unpatentable the present invention. Kang was relied upon for a disclosure of a solid state dye-sensitized solar cell in which, a counter electrode coated with polyaniline can be employed (abstract, [0024]). Accordingly, claims 6-8 and 17-20 are patentable for at least those reasons as to why claim 1 is patentable.

Concerning obviousness, *Graham V. John Deere*, 383 U.S. 1,148 U.S.P.Q. 459 (1966) outlines the approach that must be taken when determining whether an invention is obvious. In

Graham, the Court stated that a patent may not be obtained if the subject matter would have been obvious at the time the invention was made to a person having ordinary skill in the art, but emphasized that nonobviousness must be determined in the light of inquiry, not quality.

Approached in this light, §103 permits, when followed realistically, a more practical test of patentability. In accordance with *Graham*, three inquiries must be made in determining whether an invention is obvious:

- (1) The scope and content of the prior art are to be determined.
- (2) The difference between the prior art and the claims at issue are to be ascertained.
- (3) The level of ordinary skill in the pertinent art resolved.
- (4) Evaluating evidence of secondary considerations, such as commercial success, long felt but unsolved needs and failure of others, etc. Also see *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727 (2007).

Against this background, the obviousness or nonobviousness of the subject matter is determined. Secondary considerations, such as unexpected results, commercial success, long felt but unsolved needs, failure of others, etc., can be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

In conjunction with interpreting 35 U.S.C. §103 under *Graham*, the initial burden is on the Patent Office to provide some suggestion of the desirability of doing what the inventor did, i.e. the Patent Office must establish a *prima facie* case of obviousness. To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention, or the Patent Office must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.

To establish a *prima facia* case of obviousness, three basic criteria must be met:

1. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference.
2. There must be a reasonable expectation of success.
3. The prior art reference (or references when combined) must teach or suggest all the claim limitations.

The mere fact that the cited art may be modified in the manner suggested in the Office Action does not make the modification obvious, unless the cited art suggest the desirability of the modification or adequate rationale exists to do so. No such suggestion appears in the cited art in this matter nor has the requisite rationale been adequately articulated. . The Examiner's attention is kindly directed to *KSR Int'l Co. v. Teleflex, Inc*, *supra*; *In re Lee* 61 USPQ2d 1430 (Fed. Cir. 2002), *In re Dembicza et al.* 50 USPQ2d. 1614 (Fed. Cir. 1999), *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984), *In re Laskowski*, 10 USPQ2d. 1397 (Fed. Cir. 1989) and *In re Fritch*, 23, USPQ2d. 1780 (Fed. Cir. 1992).

Also, the cited art lacks the necessary direction or incentive to those of ordinary skill in the art to render a rejection under 35 USC 103 sustainable. The cited art fails to provide the degree of predictability of success of achieving the properties attainable by the present invention as discussed above needed to sustain a rejection under 35 USC 103. See *KSR Int'l Co. v. Teleflex, Inc*, *supra*; *Diversitech Corp. v. Century Steps, Inc.* 7 USPQ2d 1315 (Fed. Cir. 1988), *In re Mercier*, 187 USPQ 774 (CCPA 1975) and *In re Naylor*, 152 USPQ 106 (CCPA 1966).

Moreover, the properties of the subject matter and improvements and advantages which are inherent in the claimed subject matter and disclosed in the specification are to be considered when evaluating the question of obviousness under 35 USC 103. See *KSR Int'l Co. v. Teleflex, Inc*, *supra*; *Gillette Co. v. S.C. Johnson & Son, Inc.*, 16 USPQ2d. 1923 (Fed. Cir. 1990), *In re Antonie*, 195, USPQ 6 (CCPA 1977), *In re Estes*, 164 USPQ 519 (CCPA 1970), and *In re Papesch*, 137 USPQ 43 (CCPA 1963).

No property can be ignored in determining patentability and comparing the claimed invention to the cited art. Along these lines, see *In re Papesch*, *supra*, *In re Burt et al*, 148 USPQ 548 (CCPA 1966), *In re Ward*, 141 USPQ 227 (CCPA 1964), and *In re Cescon*, 177 USPQ 264 (CCPA 1973). In view of the above, consideration and allowance are respectfully solicited.

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In the event the Examiner believes another interview might serve in any way to advance the prosecution of this application, the undersigned is available at the telephone number noted below.

The Office is authorized to charge any necessary fees due with this paper to Deposit Account No. 22-0185, under Order No. 21713-00032-US1 from which the undersigned is authorized to draw.

Date: December 14, 2011

Respectfully submitted,

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